



(51) International Patent Classification:
E21B 31/107 (2006.01)

(21) International Application Number:
PCT/US2016/015161

(22) International Filing Date:
27 January 2016 (27.01.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
14/621,577 13 February 2015 (13.02.2015) US

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
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PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

(54) Title: RELEASE LUGS FOR A JARRING DEVICE

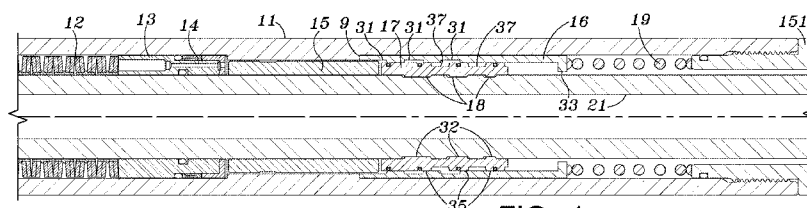


FIG. 1

(57) Abstract: A release mechanism for a jarring tool is formed by a plurality of segmented release lugs. Each lug includes a plurality of axial spaced projections on an inner surface and a plurality of grooves on an outer surface. The projections have either different widths or are separated by varying distances and releaseably engage corresponding grooves in a mandrel located within a housing of the tool. The release lugs are positioned between a trigger sleeve and the mandrel.

RELEASE LUGS FOR A JARRING DEVICE

BACKGROUND OF INVENTION

1. Field of the Invention

[0001] This invention is directed to a release mechanism for a mandrel of a jarring device commonly referred to as a jar. Jars are used in the well drilling industry to free downhole tools that may become lodged in a well. An upward or downward force can be supplied to a tubular string which includes the affected tool in order to break free the tool from the well bore.

2. Description of Related Art

[0002] Typically, a release mechanism in the form of an annular collet is provided which normally prevents axial movement of the mandrel. The mandrel is spring biased to move with significant force in an upward or downward direction. If a sufficient force is placed on the mandrel, the collet will release.

[0003] U.S. Patent No. 5,022,473 discloses a release assembly which comprises a plurality of angular segments 62 and 162 that engage in slots 86 and 88, and 186 and 188 respectively. It has been found that this arrangement can result in the segments 62 and 162 becoming out of alignment which could result in the failure of the release mechanism. As disclosed in the patent, the jar requires two sets of release lugs to withstand the anticipated tensile load. In this design the two lug assemblies must be spaced further apart than the total travel of the jar to prevent the lower lug from inadvertently engaging the groove of the upper lug assembly. If a third lug assembly were necessary it would have to be spaced a distance greater than the jar stroke from the lower set. This would significantly increase the total length of the jar and also the cost.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention solves the above noted problem by providing a plurality of angular lug segments each of which has two or more projections that engage corresponding grooves in the mandrel.

[0005] In order to avoid misalignment or a jarring situation, the projections having either a differing width or are spaced at different distances. The grooves on the mandrel have a complimentary configuration as will be explained below.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

- [0006] FIG. 1 is a cross-sectional view of a first embodiment of the release lugs as shown in a neutral position.
- [0007] FIG. 2 is a cross-sectional view of the first embodiment of the release lugs just prior to release of the mandrel.
- [0008] FIG. 3 is a cross-sectional view of the release lugs of FIG. 1 in a release position with the mandrel initially moving.
- [0009] FIG. 4 is a cross-sectional view of the mandrel in a completely released position.
- [0010] FIG. 5 is a perspective view of a release lug according to a first embodiment of the invention.
- [0011] FIG. 6 is a perspective view of a plurality of release lugs forming a release mechanism according to a first embodiment of the invention.
- [0012] FIG. 7 is a cross-sectional view of a second embodiment of the release lugs shown in a neutral position.
- [0013] FIG. 8 is a cross-sectional view of the release lugs of the second embodiment in a fully released mode.
- [0014] FIG. 9 is a segmented cross-sectional view of an entire jar including the release lugs of FIG. 7.
- [0015] FIG. 10 is a cross-sectional view taken along line 10-10 of FIG. 9.

DETAILED DESCRIPTION OF THE INVENTION

- [0016] FIG. 1 illustrates a release mechanism including a plurality of release lugs 17 surrounding mandrel 21 of the jar such as that shown in FIG. 9.
- [0017] The jar includes a central housing 11, a Belleville spring stack 12, a restrictor orifice 14 and one or more check valves 13, an annular sleeve 15 surrounding mandrel 21 and an annular trigger sleeve 16 having an inwardly projecting lip 33. Annular trigger sleeve 16 is spring biased against a shoulder 9 provided in housing 11 by a spring 19 at lip 33. A lubricant fitting housing 151 is threadedly coupled to the downhole portion of housing 11.
- [0018] As shown in FIG. 5, each release lug 17 includes a plurality of projections 18 of varying width on its interior surface. Projections 18 in this embodiment are evenly spaced from each other. The exterior surface of the release lug includes a plurality of grooves 37 which are adapted to receive projections 36 of the trigger sleeve 16 as shown in FIG. 4. A plurality of smaller grooves 41, 42, 43 and 44 are also provided on the exterior surface of

release lugs 17 and are adapted to hold garter springs 38 as shown in FIG.6. A plurality of the release lugs are used to form a release mechanism as shown in FIG. 6 having spaces 43 between the release lugs. Although six release lugs are shown any number of segments for example, 2 thru 12 may be used.

[0019] In the rest position shown in FIG. 1, surfaces 35 of the release lugs are in contact with the interior surface of trigger sleeve 16 and projections 18 are located within grooves 32 provided on the outer surface of mandrel 21. As an upward force is applied to mandrel 21 which would be from the left as shown in FIG. 1, mandrel 21 and release lugs 17 will travel to the left, thereby compressing Belleville spring stack 12. As the surfaces 35 align with grooves 31 of the trigger sleeve 16, the beveled surfaces of the projections and grooves of the trigger sleeve, release lugs and mandrel grooves will allow the surfaces to be forced outwardly into grooves 31 resulting in projections 18 disengaging from grooves 32 in the mandrel. The mandrel then is free to move in an upward direction or to the left as shown in FIG. 4. The overall operation of a hydraulic jar is well known and explained in U.S. Patent No. 6,290,004 and 7,510,008, the entire contents of which are expressly incorporate herein by reference thereto.

[0020] In order to reload the jar, a downward force is placed on the mandrel which will move the mandrel downward. The garter springs 38 will cause the release lugs to return to their original position with the projections 18 in grooves 32.

[0021] Spring 19 which is now compressed will move trigger sleeve 16 back to the neutral position shown in FIG. 1. In the embodiment of FIGS. 7 and 8, the release lugs 57 have been changed to include a plurality of projections 58 that are non-uniformly spaced apart from each other rather than having varying widths. The grooves 59 in the mandrel are also spaced apart accordingly to receive projections 59 in the neutral position as shown in FIG. 7. The outer surfaces of the release lugs are formed in the same fashion as the lugs shown in FIG. 5 so that in the released position of FIG. 8, surfaces 35 of the release lug are located within grooves 31 of the trigger sleeve 16.

[0022] FIG. 9 illustrates an embodiment of a complete jarring tool that incorporates the release lugs of the embodiment shown in FIGS. 7 and 8. The jar includes a connector 100 for connecting the jar to a tubular string, upper housing members 102 and 103, lubricating fitting 104, central housing 11, a lower lubricating fitting 151, lower housing member 152 and lower connector 141. The jar also includes a Bellville spring stack 12. The housing members are threadably connected to each other at 130, 131, 132, 133, 134 and 135. The mandrel of the jar includes an upper portion 160 which is threadedly connected to connector

100, a central portion 21 and a lower portion 153. The mandrel portions are connected together by threads at 136 and 158. Suitable seals are provided at 121, 122, 123, 124, 125, 126, 129 and 139. A floating piston 127 surrounds the lower portion of mandrel 153. A lubricating material is introduced into the housing through fittings 140 and 141. The upper portion of the mandrel 160 includes an annular raised portion 138 which acts as a hammer against an anvil shoulder 137 on housing upper end member 102. As shown in FIG. 10, upper housing member 103 may comprise a hexagon surface 171 which received a hexagon outer surface 172 on the mandrel portion 160.

[0023] The jarring tool of FIG. 9 may incorporate the release lugs shown in the embodiments of FIG. 5 or that of the embodiment of FIGS. 7 and 8.

[0024] Although the present invention has been described with respect to specific details, it is not intended that such details should be regarded as limitations on the scope of the invention, except to the extent that they are included in the accompanying claims.

CLAIM(S)

1. A release mechanism for a jarring tool having a mandrel comprising:
 - a plurality of arcuate release lugs, each release lug including an inner surface and an outer surface;
 - a plurality of axially spaced projections on the inner surface of the release lugs and a plurality of grooves on the outer surface of the release lugs;
 - a mandrel having a plurality of axially spaced grooves on an outer surface of the mandrel; and
 - an annular trigger sleeve surrounding the mandrel, the release lugs being positioned between the annular trigger sleeve and the mandrel.
2. A release mechanism for a jarring tool as claimed in claim 1 wherein the projections have different axial widths.
3. A release mechanism for a jarring tool as claimed in claim 2 wherein the grooves in the mandrel have a width corresponding to the width of the projections on the inner surface of the release lugs.
4. A release mechanism for a jarring tool as claimed in claim 1 including three projections that are axially spaced from each other by a different distance.
5. A release mechanism for a jarring tool as claimed in claim 4 including at least three grooves in the outer surface of the mandrel, the grooves being axially spaced from each other by a different distance.
6. A jarring tool comprising:
 - a housing;
 - a mandrel having a plurality of axially spaced grooves;
 - a trigger sleeve surrounding the mandrel;
 - a plurality of axially extending arcuate release lugs having an inner and outer surface, each lug including a plurality of axially spaced projections on its inner surface and a plurality of grooves on its outer surface;
 - said release lugs being positioned between the mandrel and the trigger sleeve; and
 - a spring means surrounding the mandrel.
7. A jarring tool as claimed in claim 6 wherein the projections have varying widths.

8. A jarring tool as claimed in claim 6 including three projections that are axially spaced from each other of a different distance.
9. A jarring tool as claimed in claim 6 further including an anvil on the housing and a hammer surface on the mandrel.
10. A jarring tool as claimed in claim 6 further including a plurality of garter springs surrounding the release lugs thereby forming a circular array of release lugs which engages an outer surface of the mandrel.

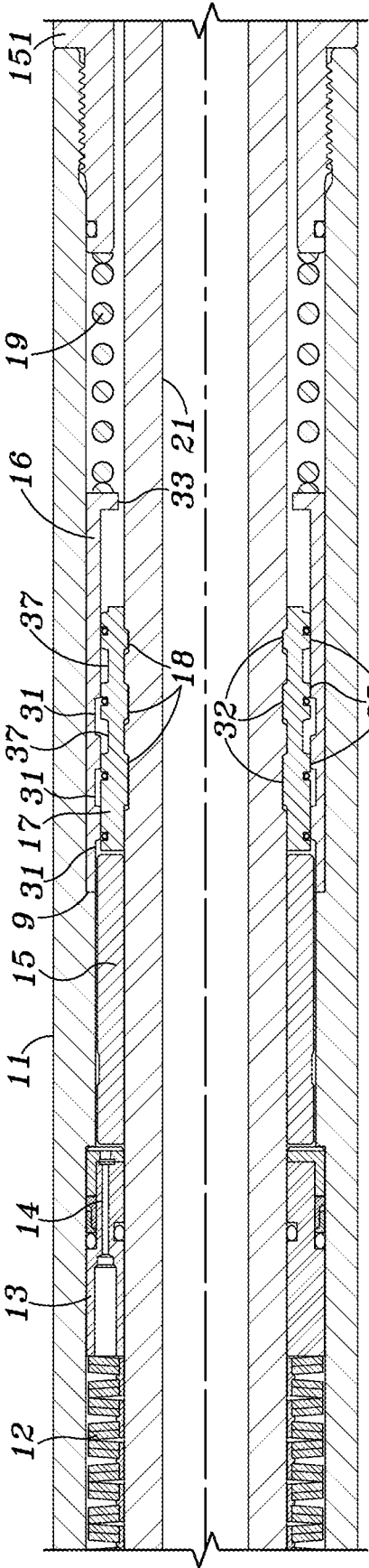


FIG. 1

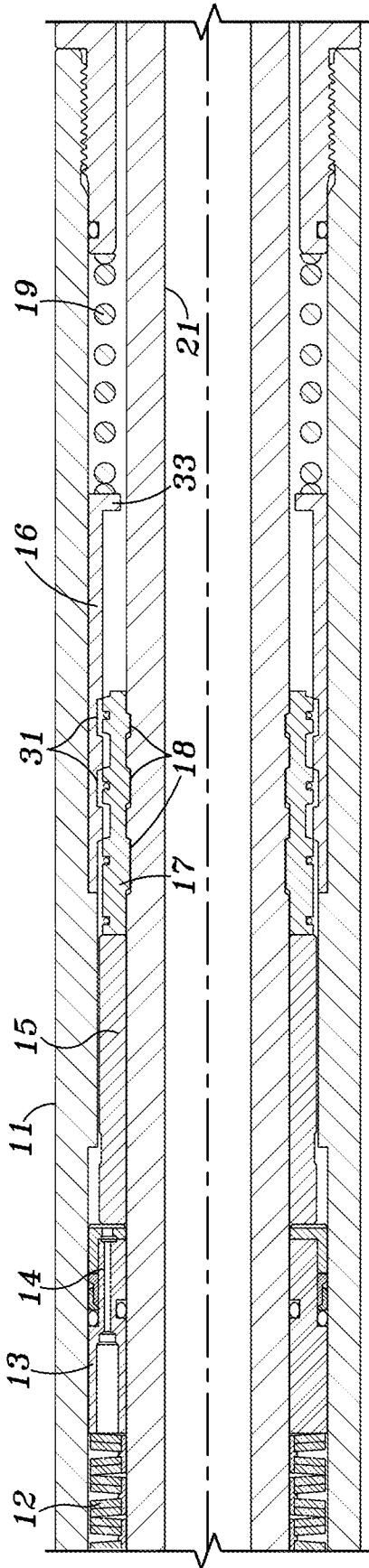


FIG. 2

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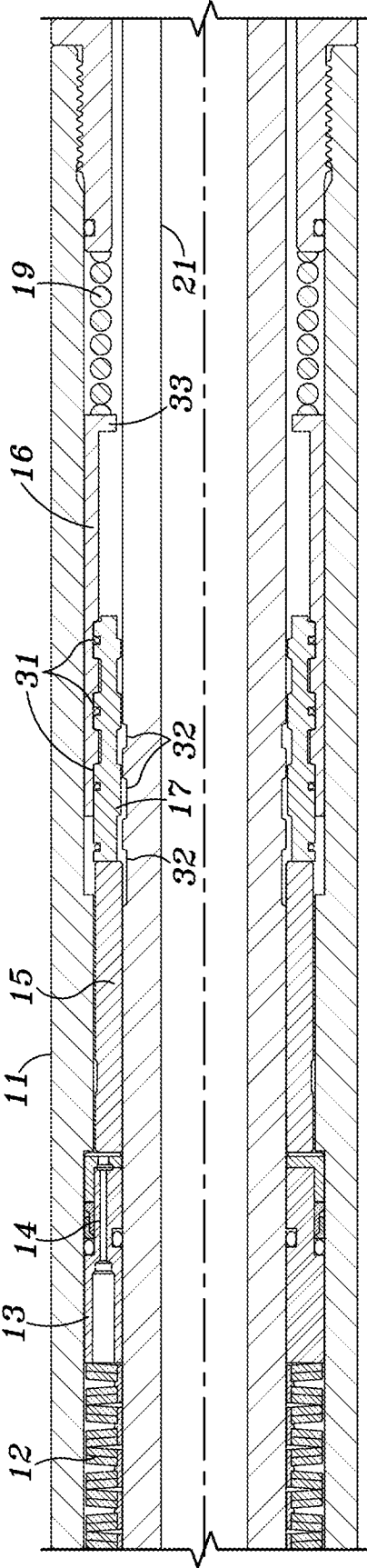


FIG. 3

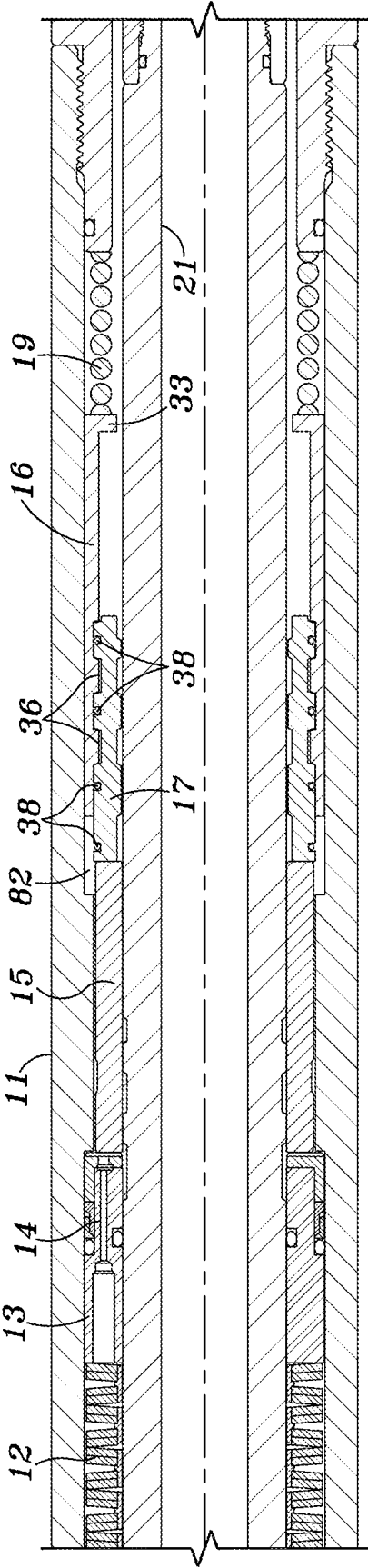
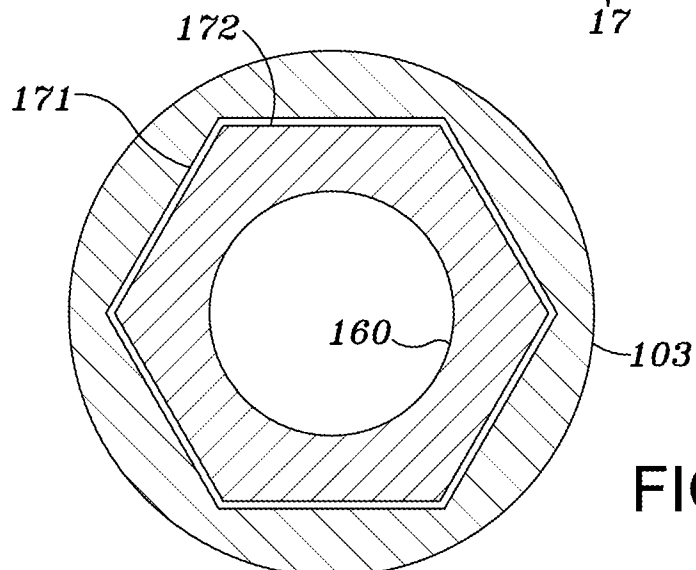
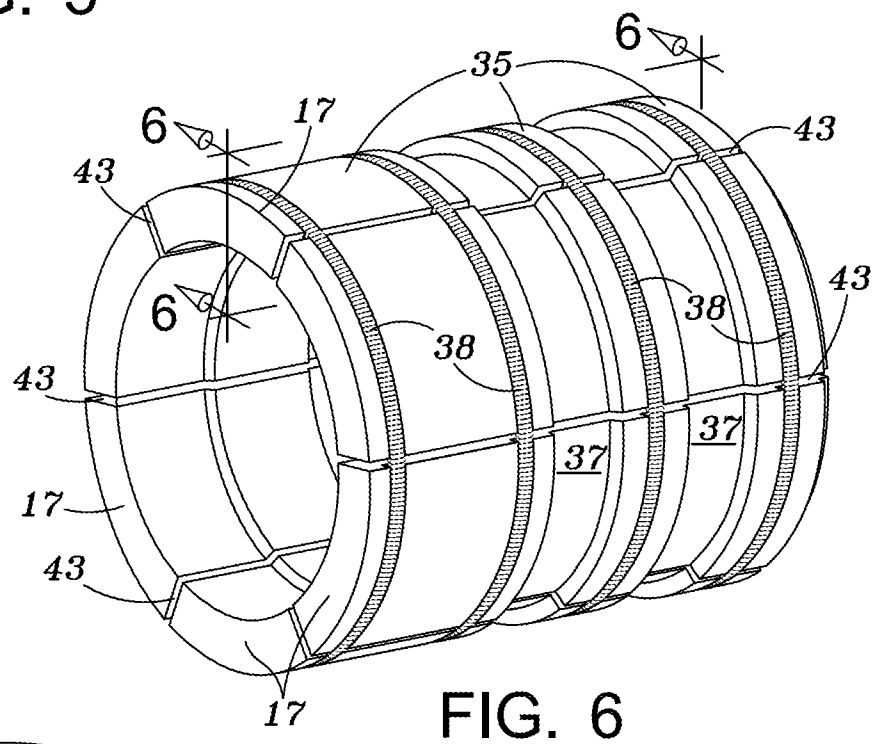
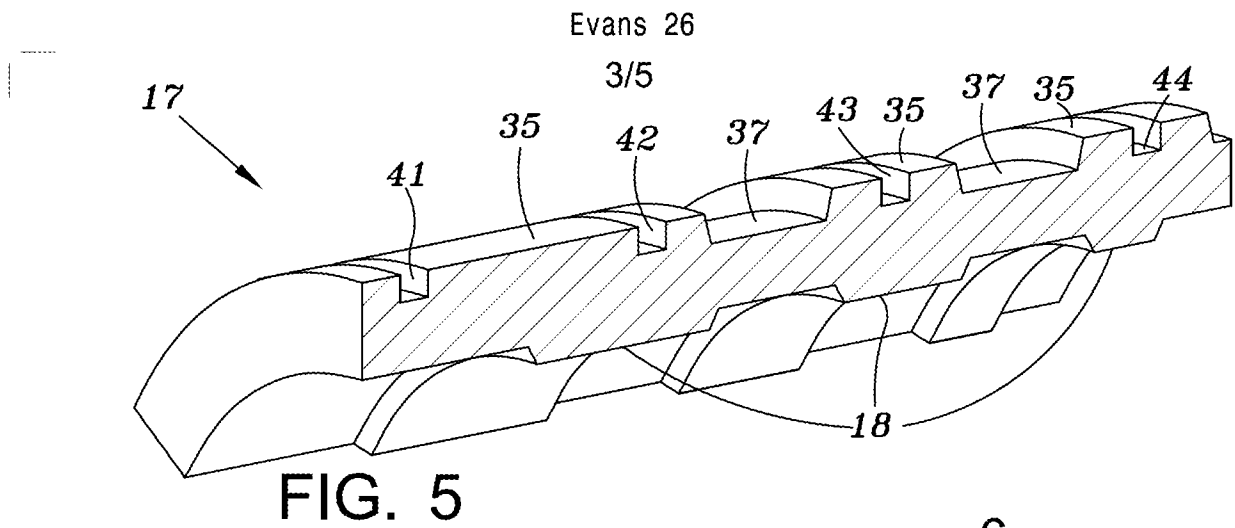


FIG. 4



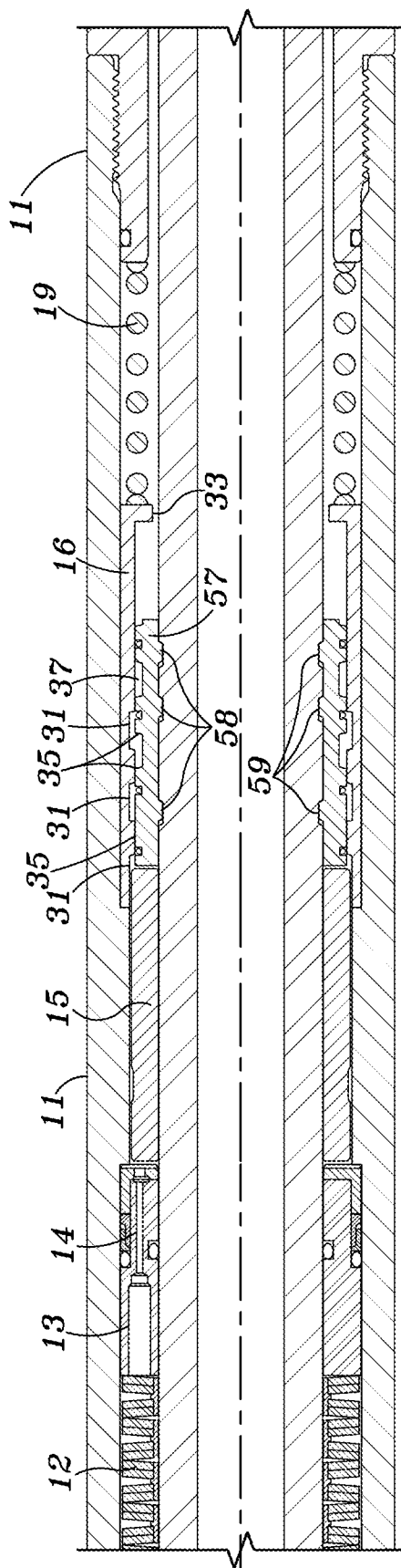
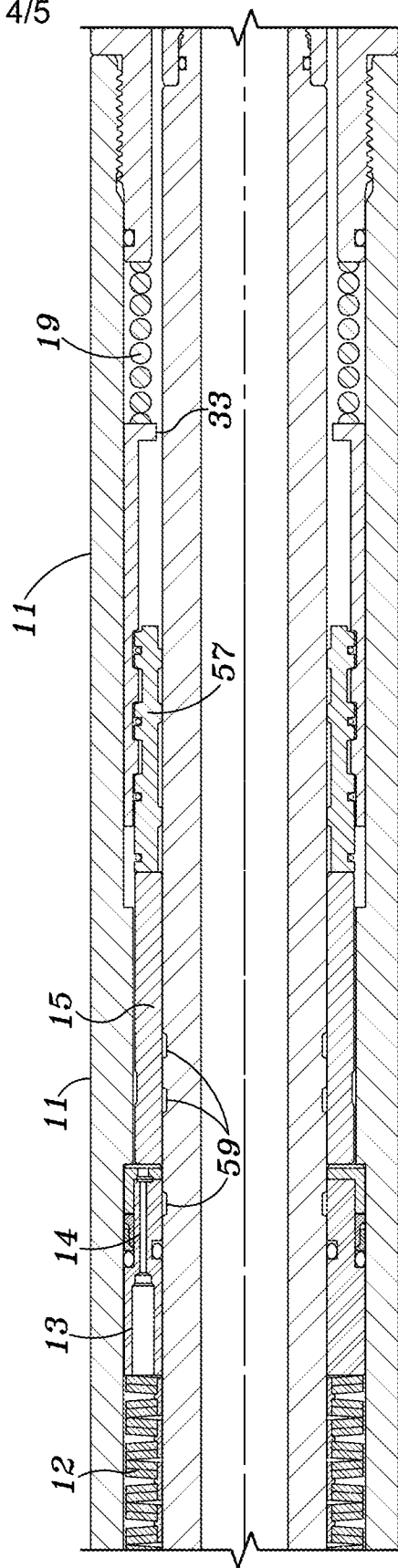


FIG. 7



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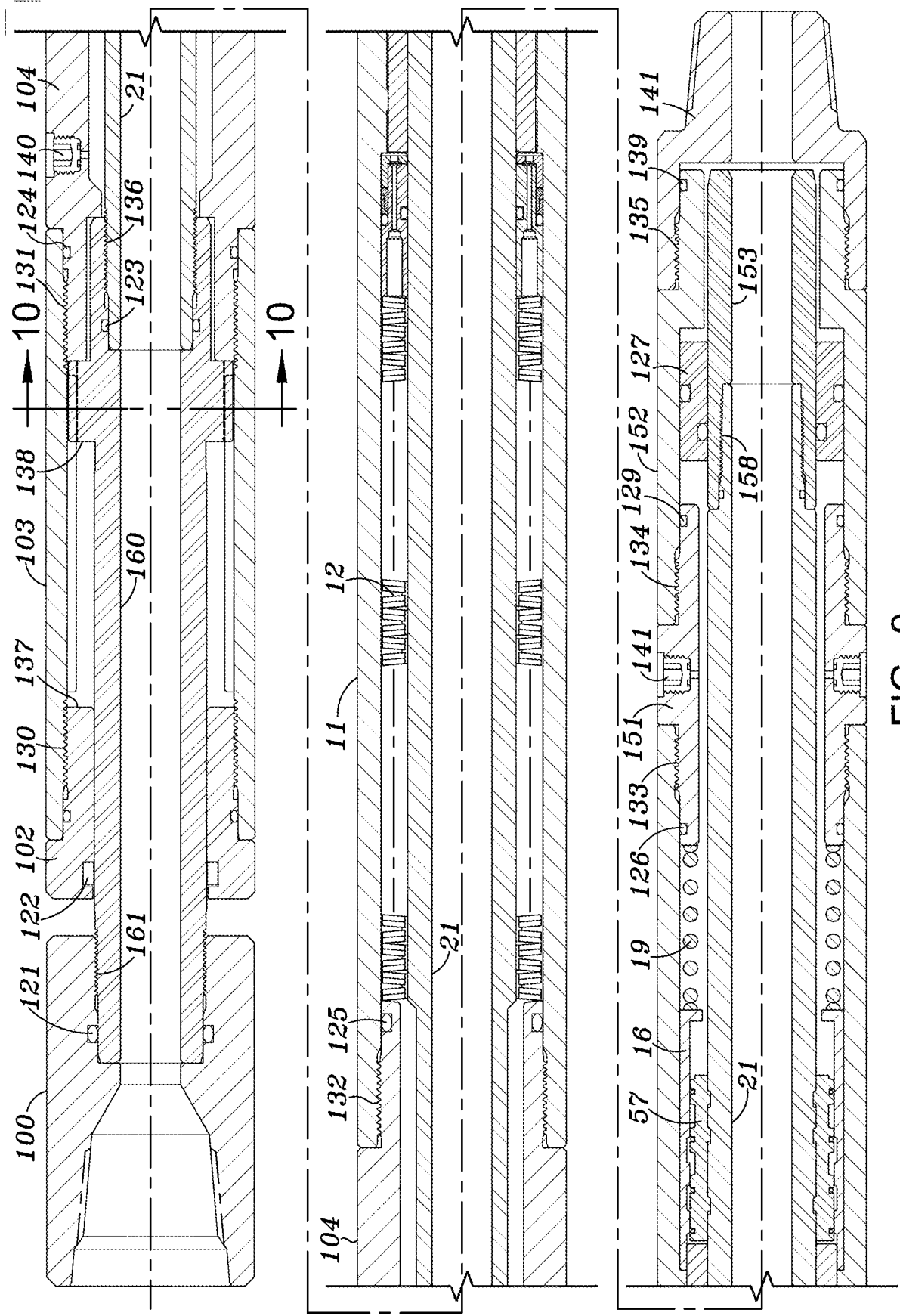


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/15161

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 31/107 (2016.01)

CPC - E21B 31/107

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC (8): E21B 31/107 (2016.01)

CPC: E21B 31/107

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC (8): E21B 31/10, E21B 31/00 (2016.01). CPC: E21B 1/10, E21B 31/10, E21B 31/00. USPC: 166/301, 166/178, 175/304, 175/302

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google (Patent, Web, Scholar). Search Terms: Alias, Anvil, Borehole, Collet, Downhole, Drill, Dynamic, Fish, Groove, Hammer, Jar, Key, Latch, Lock, Lug, Mandrel, Mechanical, Register, Registration, Rib, Simultaneous, Slickline, String, Subterranean, Synchronize, Thread, Thread, Tool, Tumbler, Well, Wellbore

C. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7,510,008 B2 (EVANS) 31 March 2009 (31.03.2009) Figs. 1A, 2A-C, 3, 4A; col 2 ln 28-32, 49-51, 62-63, 66-68, col 3 ln 1-2, col 4 ln 13-16, 21,23.	1-5
A	US 5,069,282 A (TAYLOR) 03 December 1992 (03.12.1992) Figs. 2A-C, 3-4; col 4 ln 19-49, col 5 ln 18-30.	1-5
A	US 3,685,599 A (KISLING, III) 22 August 1972 (22.08.1972) Figs. 1-3; col 2 ln 40-55, col 3 ln 17-31.	1-5
A	US 3,371,730 A (NEWMAN) 15 June 1971 (15.06.1971) Figs. 1A-C, 2, 4-7; col 2 ln 42-61, col 4 ln 3 ln 39 - col 4 ln 4.	1-5
A	US 8,720,540 B2 (GANO) 13 May 2014 (13.05.2014) Figs. 1, 2A-B, col 5 ln 27-62, col 6 ln 46 - col 7 ln 48.	1-5
A	US 4,376,468 A (CLARK) 15 March 1983 (15.03.1983) Figs. 1A-B, 2-3; col 3 ln 4-29, 44 - col 4 ln 44.	1-5

☐ Further documents are listed in the continuation of Box C.


* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

05 April 2016 (05.04.2016)

Date of mailing of the international search report

11 JUL 2016

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

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Facsimile No. 571-273-8300

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PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/15161

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I Claims 1-5, directed to a release mechanism for a jarring tool having a mandrel.

Group II Claims 6-10, directed to a jarring tool comprising a housing and spring means.

.- See Supplemental Sheet -.-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-5

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/15161

-*- Continuation of Box III - Observations where unity of invention is lacking -*-

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

Group I requires the special technical features of a release mechanism, an annular trigger sleeve, and a plurality of axially spaced grooves on an outer surface of the mandrel, not required by Group II.

Group II requires the special technical features of a housing and a spring means surrounding the mandrel, not required by Group I.

The only shared technical feature(s) that would otherwise unify Groups I-II are a jarring tool comprising

- a plurality of arcuate release lugs, each lug having an inner surface and an outer surface,
- a plurality of axially spaced projections on the inner surface of the release lugs and a plurality of grooves on the outer surface of the release lugs;

- a mandrel having a plurality of axially spaced grooves,

- a trigger sleeve surrounding the mandrel, the release lugs being positioned between the trigger sleeve and the mandrel.

However, these technical features do not represent a contribution to the prior art, because they are anticipated by US 7,510,008 B2 (EVANS).

Evans discloses a jarring tool (jar 10, Fig. 2A; col 2 ln 49-51) comprising

- a plurality of arcuate release lugs (unnumbered; prong of collet 48 illustrated in Fig. 3 surrounding slot 62; col 4 ln 17-23), each lug having an inner surface (unnumbered; generally cylindrical surfaces interior to 48, i.e., to the left of the leader line for 64 as illustrated in Fig. 3; col 4 ln 13-16) and an outer surface (unnumbered; generally cylindrical surfaces adjacent termination of leader line for 48 as illustrated in Fig. 3; col 4 ln 13-16),

- a plurality of axially spaced projections on the inner surface of the release lugs (unnumbered; landings between grooves in collet 48 shown adjacent grooves 47 on outside surface of mandrel 20 as illustrated in Fig. 2A; "cylindrical protuberances and grooves on the inside of collet 48" col 2 ln 64-66) and a plurality of grooves on the outer surface of the release lugs (unnumbered; grooves between secondary protrusions 60B illustrated in Fig. 3; col 4 ln 21-23);

- a mandrel (20, Fig. 1A; col 2 ln 29-32) having a plurality of axially spaced grooves (47, Fig. 2C; col 2 ln 64-66),

- a trigger sleeve (50, Fig. 2A; col 2 ln 66 - col 3 ln 2) surrounding the mandrel (as illustrated in Fig. 2A), the release lugs being positioned between the trigger sleeve and the mandrel (as illustrated in Fig. 2A).

As the common technical feature(s) of Groups I-II were known in the art at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I-II.

Therefore, Groups I-II lack unity under PCT Rule 13.

Note: Not all release mechanisms are configured to use lugs; some may include hydraulic pistons, compressive elastomeric retainers, or cam surface ledges, where a plurality of prongs, lugs, or jaws are not provided. Moreover, it is at least theoretically possible that some release lugs do not inherently constitute, or are not capable of, comprising a release mechanism.